AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A polishing head for ~~positioning~~ polishing a surface of a substrate against a polishing pad surface to achieve an even removal of material near the substrate surface edge and interior to the substrate surface edge, the polishing pad surface having a hardness and undergoing a deformation when a pressure force is applied and having at least a partial rebound from the deformation in a first time period after a portion of the pressure force is removed and having a full rebound in a second time period after all the pressure force is removed, the polishing pad being viscoelastic so that it exhibits different elastic properties to force applied in different directions or for different lengths of times and having a thickness that changes over time, the polishing head comprising:

a carrier;

a subcarrier carried by the carrier and adapted to hold the substrate during a polishing operation; and

a retaining ring having an inner edge disposed about the subcarrier and a lower surface in contact with the polishing surface during the polishing operation, the lower surface of the retaining ring having at least one ~~annular~~ recess disposed along a substantially annular path on the lower surface of the retaining ring and sized in width and depth so that the polishing pad surface adjacent the recess at any moment during polishing partially rebounds an amount of the polishing pad into the recess so that the polishing pad surface fully rebounds in a shorter time and in a shorter distance after moving under the substrate across the inner edge of the retaining ring, the force on the substrate in an area near the outer edge of the substrate being thereby adjusted to achieve a predetermined polishing effect where the amount of material removed from the substrate surface edge is substantially the same as the amount of material removed interior to the substrate surface edge, the at least one ~~annular~~ recess positioned a predetermined distance from the inner edge of the retaining ring~~, the predetermined distance~~ selected based on a magnitude of a first force applied to the retaining ring during the polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both.

2. (Currently Amended) A polishing head according to claim [[1]] 42, wherein the polishing surface comprises a pad of pliant material capable of being deformed by the retaining ring during the polishing operation.

3. (Previously Presented) A polishing head according to claim 2, wherein the at least one annular recess is adapted to reduce a length of time during which the polishing surface is deformed by the retaining as the retaining ring is moved relative to the polishing surface.

4. (Cancelled)

5. (Previously Presented) A polishing head according to claim 1, wherein the at least one annular recess is positioned a predetermined distance from the inner edge of the retaining ring, the predetermined distance selected to reduce the area near the edge of the substrate having a lower polishing rate than a center of the substrate due to rebounding of the pad.

6. (Cancelled)

7. (Previously Presented) A polishing head according to claim 1, wherein the predetermined distance is selected based on a hardness of the polishing surface.

8. (Previously Presented) A polishing head according to claim 9, wherein the predetermined depth and the predetermined radial width are selected to reduce the area near the edge of the substrate having a lower polishing rate than a center of the substrate due to rebounding of the polishing surface.

9. (Currently Amended) A polishing head for ~~positioning~~ polishing a surface of a substrate against a polishing pad surface to achieve an even removal of material near the substrate surface edge and interior to the substrate surface edge, the polishing pad surface having a hardness and undergoing a deformation when a pressure force is applied and having at least a partial rebound from the deformation in a first time period after a portion of the pressure force is removed and having a full rebound in a second time period after all the pressure force is removed, the polishing pad being viscoelastic so that it exhibits different elastic properties to force applied in different directions or for different lengths of times and having a thickness that changes over time, the polishing head comprising:

a carrier;

a subcarrier carried by the carrier and adapted to hold the substrate during a polishing operation; and

a retaining ring having an inner edge disposed about the subcarrier and a lower surface in contact with the polishing surface during the polishing operation, the lower surface of the retaining ring having at least one annular recess disposed along a substantially annular path on the lower surface of the retaining ring and sized in width and depth so that the polishing pad surface adjacent the recess at any moment during polishing partially rebounds an amount of the polishing pad into the recess so that the polishing pad surface fully rebounds in a shorter time and in a shorter distance after moving under the substrate across the inner edge of the retaining ring, the force on the substrate in an area near the outer edge of the substrate being thereby adjusted to achieve a predetermined polishing effect where the amount of material removed from the substrate surface edge is substantially the same as the amount of material removed interior to the substrate surface edge, the annular recess having a predetermined depth and a predetermined radial width, the predetermined depth and the predetermined radial width selected

based on a magnitude of a first force applied to the retaining ring during the polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both.

10. (Previously Presented) A polishing head according to claim 9, wherein the predetermined depth and the predetermined radial width are selected based on a hardness of the polishing surface.

11. (Currently Amended) A polishing head for ~~positioning~~ polishing a surface of a substrate against a polishing surface to achieve an even removal of material near the substrate surface edge and interior to the substrate surface edge, the polishing pad surface having a hardness and undergoing a deformation when a pressure force is applied and having at least a partial rebound from the deformation in a first time period after a portion of the pressure force is removed and having a full rebound in a second time period after all the pressure force is removed, the polishing pad being viscoelastic so that it exhibits different elastic properties to force applied in different directions or for different lengths of times and having a thickness that changes over time, the polishing head comprising:

a carrier;

a subcarrier carried by the carrier and adapted to hold the substrate during a polishing operation; and

a retaining ring having an inner edge disposed about the subcarrier and a lower surface in contact with the polishing surface during the polishing operation, the lower surface of the retaining ring having at least one annular recess disposed along a substantially annular path on the lower surface of the retaining ring and sized in width and depth so that the polishing pad surface adjacent the recess at any moment during polishing partially rebounds an amount of the polishing pad into the recess so that the polishing pad surface fully rebounds in a shorter time and in a shorter distance after moving under the substrate across the inner edge of the retaining ring, the force on the substrate in an area near the outer edge of the substrate being thereby adjusted to achieve a predetermined polishing effect where the amount of material removed from the substrate surface edge is substantially the same as the amount of material removed interior to the substrate surface edge, the annular recess positioned a predetermined distance from the inner edge of the retaining ring selected based on a magnitude of a first force applied to the retaining ring during the polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both, and wherein the at least one annular recess comprises a groove having a curved cross-sectional area in a plane perpendicular to the lower surface of the retaining ring.

12. (Original) A polishing head according to claim 11, wherein the groove comprises a hemispherical cross-sectional area.

13. (Original) A polishing head according to claim 1, wherein the at least one annular recess comprises a plurality of concentric grooves.

14. (Previously Presented) A Chemical Mechanical Polishing (CMP) apparatus having a polishing head according to claim 1, the CMP apparatus further comprising:

a chemical dispensing mechanism adapted to dispense chemical onto the polishing surface during the polishing operation; and

a drive mechanism adapted to move the polishing head relative to the polishing surface during the polishing operation.

15. (Currently Amended) A method of polishing a substrate having a surface using a polishing apparatus comprising a polishing surface, a carrier having a subcarrier and a retaining ring circumferentially disposed about the subcarrier, the retaining ring having a lower surface with at least one recess formed therein, the method comprising:

selecting the at least one recess to be disposed along a substantially annular path on the lower surface of the retaining ring and sized in width and depth so that the polishing pad surface adjacent the recess at any moment during polishing partially rebounds an amount of the polishing pad into the recess so that the polishing pad surface fully rebounds in a shorter time and in a shorter distance after moving under the substrate across the inner edge of the retaining ring, the force on the substrate in an area near the outer edge of the substrate being thereby adjusted to achieve a predetermined polishing effect where the amount of material removed from the substrate surface edge is substantially the same as the amount of material removed interior to the substrate surface edge, the at least one recess positioned a predetermined distance from the inner edge of the retaining ring selected based on a magnitude of a first force applied to the retaining ring during the polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both;

positioning the substrate on the subcarrier;

pressing the surface of the substrate and the lower surface of the retaining ring against the polishing surface and ~~,~~ deforming the polishing surface under the retaining ring;

providing relative motion between the carrier and the polishing surface to polish the surface of the substrate; and

enabling the polishing pad surface deformed under the retaining ring to partially rebound within the recess, the at least one recess positioned a predetermined distance from the inner edge of the retaining ring, the predetermined distance selected to reduce the area near the edge of the substrate having a lower polishing rate than a center of the substrate due to rebounding of the polishing surface, the predetermined distance selected based on a magnitude of a first force applied to the retaining ring

during a polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both.

16. (Original) A method according claim 15, wherein the polishing surface comprises a pad of pliant material capable of being deformed by the retaining ring during the polishing operation, and wherein the step of pressing the lower surface of the retaining ring against the polishing surface comprises the step of reducing an area near an edge of the substrate having a lower polishing rate than a center of the substrate due to rebounding of the pad from a deformed condition in a first region near the inner edge of the retaining ring.

17. (Original) A substrate having a surface polished according to the method of claim 15.

18. (Previously Presented) A polishing head according to claim 1, wherein the retaining ring comprises a polymer to inhibit spalling of the lower surface during the polishing operation.

19. (Original) A polishing head according to claim 18, wherein the polymer is selected to provide an operating life for the retaining ring adequate for processing at least about 2,000 substrates.

20. (Original) A polishing head according to claim 18, wherein the retaining ring is made entirely or in part of a polymer selected from a group consisting of:

polyesters;
polyethylene terephthalate;
polyimide;
polyphenylene sulfide;
polyetherketone; and
polybenzimidazole.

21. (Cancelled)

22. (Cancelled)

23. (Cancelled)

24. (Cancelled)

25. (Previously Presented) A polishing head according to claim 9, wherein the at least one annular recess comprises a plurality of concentric grooves.

26. (Previously Presented) A polishing head according to claim 11, wherein the at least one annular recess comprises a plurality of concentric grooves.

27. (Previously Presented) A Chemical Mechanical Polishing (CMP) apparatus having a polishing head according to claim 9, the CMP apparatus further comprising:

a chemical dispensing mechanism adapted to dispense chemical onto the polishing surface during the polishing operation; and

a drive mechanism adapted to move the polishing head relative to the polishing surface during the polishing operation.

28. (Previously Presented) A Chemical Mechanical Polishing (CMP) apparatus having a polishing head according to claim 11, the CMP apparatus further comprising:

a chemical dispensing mechanism adapted to dispense chemical onto the polishing surface during the polishing operation; and

a drive mechanism adapted to move the polishing head relative to the polishing surface during the polishing operation.

29. (Previously Presented) A method according to claim 15, wherein the recess comprises an annular recess.

30. (Currently Amended) A method of polishing a substrate having a surface using a polishing apparatus comprising a polishing pad surface, a carrier having a subcarrier and a retaining ring circumferentially disposed about the subcarrier, the retaining ring having a lower surface with at least one ~~an annular~~ recess formed therein, the method comprising:

selecting the at least one recess to be disposed along a substantially annular path on the lower surface of the retaining ring and sized in width and depth so that the polishing pad surface adjacent the recess at any moment during polishing partially rebounds an amount of the polishing pad into the recess so that the polishing pad surface fully rebounds in a shorter time and in a shorter distance after moving under the substrate across the inner edge of the retaining ring, the force on the substrate in an area near the outer edge of the substrate being thereby adjusted to achieve a predetermined polishing effect where the amount of material removed from the substrate surface edge is substantially the same as the amount of material removed interior to the substrate surface edge, the at least one recess positioned a predetermined distance from the inner edge of the retaining ring selected based on a magnitude of a first

force applied to the retaining ring during the polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both;

positioning the substrate on the subcarrier;

pressing the surface of the substrate and the lower surface of the retaining ring against the polishing pad surface, deforming the polishing surface under the retaining ring;

providing relative motion between the carrier and the polishing pad surface to polish the surface of the substrate; and

enabling the polishing pad surface deformed under the retaining ring to partially rebound within the ~~annular~~ at least one recess, the ~~annular~~ at least one recess having a predetermined depth and a predetermined radial width, the predetermined depth and the predetermined radial width selected based on a magnitude of a first force applied to the retaining ring during a polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both.

31. (Previously Presented) A substrate having a surface polished according to the method of claim 30.

32. (Currently Amended) A method of polishing a substrate having a surface using a polishing apparatus comprising a polishing surface, a carrier having a subcarrier and a retaining ring circumferentially disposed about the subcarrier, the retaining ring having a lower surface with an annular recess formed therein, the method comprising:

selecting the annular recess to be disposed along a substantially annular path on the lower surface of the retaining ring and sized in width and depth so that the polishing pad surface adjacent the recess at any moment during polishing partially rebounds an amount of the polishing pad into the recess so that the polishing pad surface fully rebounds in a shorter time and in a shorter distance after moving under the substrate across the inner edge of the retaining ring, the force on the substrate in an area near the outer edge of the substrate being thereby adjusted to achieve a predetermined polishing effect where the amount of material removed from the substrate surface edge is substantially the same as the amount of material removed interior to the substrate surface edge, the annular recess positioned a predetermined distance from the inner edge of the retaining ring selected based on a magnitude of a first force applied to the retaining ring during the polishing operation, a magnitude of a second force applied to the subcarrier during the polishing operation, or both;

positioning the substrate on the subcarrier;

pressing the surface of the substrate and the lower surface of the retaining ring against the polishing surface, deforming the polishing surface under the retaining ring;

providing relative motion between the carrier and the polishing surface to polish the surface of the substrate; and

enabling the polishing surface deformed under the retaining ring to partially rebound within the annular recess, wherein the annular recess comprises a groove having a curved cross-sectional area in a plane perpendicular to the lower surface of the retaining ring.

33. (Previously Presented) A substrate having a surface polished according to the method of claim 32.

34. (Withdrawn) A polishing head for positioning a surface of a substrate against a polishing surface, the polishing head comprising:

a carrier;

a subcarrier carried by the carrier and adapted to hold the substrate during a polishing operation; and

a retaining ring having an inner edge disposed about the subcarrier and a lower surface in contact with a polishing surface during the polishing operation, the lower surface of the retaining ring having a plurality of individual recesses distributed across the lower surface of the retaining ring.

35. (Withdrawn) A polishing head according to claim 34, wherein at least one of the individual recesses comprises a hemispherical recess.

36. (Withdrawn) A polishing head according to claim 34, wherein at least one of the individual recesses comprises a dimple.

37. (Withdrawn) A polishing head according to claim 34, wherein said retaining ring comprises a polymer.

38. (Withdrawn) A polishing head according to claim 34, wherein said polishing surface comprises a polishing pad.

39. (Withdrawn) A polishing head according to claim 34, wherein said polishing of said substrate results in a planarization of said surface of said substrate.

40. (Withdrawn) A polishing head according to claim 34, wherein said substrate comprises a semiconductor wafer substrate.

41. (Previously Presented) A semiconductor wafer having a surface polished according to the method of claim 32.

42. (New) A polishing head according to claim 1, wherein said at least one recess comprises at least one annular recess.

43. (New) A polishing head according to claim 1, wherein said at least one recess comprises a plurality of individual recesses distributed across the lower surface of the retaining ring, each at a predetermined distance from the inner edge of the retaining ring.

44. (New) A polishing head according to claim 43, wherein the plurality of individual recesses distributed across the lower surface of the retaining ring comprise a plurality of individual unconnected apertures that open onto the lower surface of the retaining ring.

45. (New) A polishing head according to claim 44, wherein plurality of individual unconnected apertures that open onto the lower surface of the retaining ring comprise apertures having a substantially circular opening onto the lower surface of the retaining ring and a hemispherical cross-sectional area.

46. (New) A polishing head according to claim 44, wherein plurality of individual unconnected apertures that open onto the lower surface of the retaining ring comprise apertures wherein the individual aperture recesses have a number, an area, a size, and a location that differ between at least some of the recesses and are different from other or the aperture recesses and are varied to achieve a desired polishing pad rebound.

47. (New) A polishing head according to claim 1, wherein the predetermined distance for the or each recess is selected based on both the magnitude of the force applied to the retaining ring during the polishing operation and the magnitude of the force applied to the subcarrier during the polishing operation.

48. (New) A polishing head according to claim 1, wherein the retaining ring is sized for a 300mm diameter substrate, the recess includes an annular groove positioned from 1mm to 5mm from the inner edge of the retaining ring and having a width of from 0.1mm to 10mm and a depth of from 0.1mm to 5mm.

49. (New) A polishing head according to claim 1, wherein the at least one recess comprises a plurality of annular groove shaped recesses wherein at least a first one of the plurality of annular groove shaped recesses has a different depth from a second one of the plurality of annular groove shaped recesses.

50. (New) A polishing head according to claim 1, wherein the at least one recess comprises a plurality of annular groove shaped recesses, and wherein at least a first one of the plurality of annular groove shaped recesses has a different width from a second one of the plurality of annular groove shaped recesses.

51. (New) A polishing head according to claim 1, wherein the at least one recess comprises a plurality of annular groove shaped recesses, and wherein at least a first one of the plurality of annular groove shaped recesses has a different depth and width from a second one of the plurality of annular groove shaped recesses.

52. (New) A polishing head according to claim 1, wherein the at least one recess comprises a plurality of separate retaining rings disposed in spaced-apart relationship to define spaces there between having depths and widths defined by the vertical height of the spaced apart retaining rings.

53. (New) A polishing head according to claim 1, wherein the at least one recess comprises a separate first and second retaining rings disposed in spaced-apart relationship to define a space there between having a depth and width defined by the vertical height of the first and second retaining rings.

54. (New) A polishing head according to claim 1, wherein the at least one recess has a triangular cross-section.

55. (New) A polishing head according to claim 1, wherein the retaining ring is formed with a ceramic core and a polymer covering.

56. (New) A polishing head according to claim 1, wherein the width, depth, shape, and location of the at least one recess is selected based on the hardness of the polishing pad, the force applied to the retaining ring, and the speed with which the polishing head is moved relative to the polishing surface during a polishing operation.

57. (New) A polishing head according to claim 9, the predetermined depth and the predetermined radial width are selected based on both the magnitude of the first force applied to the retaining ring during the polishing operation, and the magnitude of the second force applied to the subcarrier during the polishing operation.